

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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TITLE: LINEAR ACTUATOR COMPRISING A BRUSHLESS POLYPHASE ELECTRIC MOTOR

Preliminary Amendment: CLAIM AMENDMENTS

1. (Currently amended) Linear actuator comprising:

a brushless multiphase synchronous electric motor ~~(2)~~ including having a stator ~~(3)~~ and a rotor ~~(4)~~, ~~the latter~~ acting on a control organ ~~( $\Theta$ )~~ through a driving means ~~(5)~~ designed capable of for converting, over several revolutions, its rotational movement into a linear displacement, ~~characterized in that;~~

it ~~includes a~~ springy and/or magnetic restoring means ~~(21)~~ designed capable of for systematically restoring the control ~~unit~~ ~~( $\Theta$ )~~ organ into a reference position in the event of interruption of the power supply to the motor ~~(2)~~;

~~the motor (2) includes a~~ position-detection device ~~(25; 25A)~~ of the motor contributing, in combination with an electronic control unit, to the control or the adjustment of the position of the rotor ~~(4)~~, ~~hence of~~ and the control organ ~~( $\Theta$ )~~; and

~~and with the driving means (5), designed capable of converting the rotational motion of the rotor (4) into a linear movement,~~ is associated an independent reversible reduction device ~~(43)~~ associated with the driving means.

2. (Currently amended) Linear actuator according to claim 1, ~~characterized in that the~~ wherein said springy and/or magnetic restoring means (21) are ~~in the form~~ comprised of at least one springy and/or magnetic element (22) ~~for controlling the rotation of the rotor (4) designed capable,~~ by an action actionable on the latter said rotor, of restoring to restore the control organ ( $\Theta$ ), ~~starting and startable~~ from any position previously imparted to it by the motor (2), into said reference position.

3. (Currently amended) Linear actuator according ~~to any of the preceding claims,~~ ~~characterized in that the~~ Claim 1, wherein said springy and/or magnetic restoring means (21) are ~~defined by~~ comprised of a springy and/or magnetic element (23) ~~designed capable of acting~~ actable directly on the control organ ( $\Theta$ ) in order to restore it, ~~starting the control organ and startable~~ from any position imparted to it by the motor (2), into said reference position.

4. (Currently amended) Actuator according to claim 1, ~~characterized in that the~~ wherein said springy and/or magnetic restoring means (21) are ~~defined in the form~~ comprised of a combination of a springy and/or magnetic element (22) ~~for controlling the rotation of the rotor (2) and of a springy and/or magnetic element (23)~~ actingactable directly on the control organ ( $\Theta$ ), ~~this so as to restore this the control organ ( $\Theta$ ) into a reference position, starting and being startable~~ from any position previously imparted to it by the motor (2).

5. (Currently amended) Linear actuator according to ~~any of the preceding claims,~~  
~~characterized in that the~~ Claim 1, wherein said driving means (5) ~~designed capable of~~ for converting  
the rotational motion of the rotor (4) into a linear movement ~~are designed of a~~ is reversible type.

6. (Currently amended) Linear actuator according to ~~any of the preceding claims,~~  
~~characterized in that the~~ Claim 1, wherein said driving means (5) ~~designed capable of~~ for converting  
the rotational movement of the rotor (4) into a linear movement ~~are defined by~~ comprised of a screw  
and nut system (14), the rotor (4) ~~including~~ having, at the level of an axial bore (15), a nut (16)  
engaged with a coaxial threaded rod (17; 17A; 17B) ~~designed capable of~~ defining, directly or  
indirectly, the control organ (Θ).

7. (Currently amended) Linear actuator according to claim 6, ~~characterized in that the~~  
~~wherein said~~ nut (16) carried by the rotor (4) is mounted moveably on a fixed threaded rod (17B) so  
as to be ~~capable of moving~~ movable, according a helical motion, under the stator (3) and of  
~~transmitting its~~ having a linear displacement thereof transmittable to the control organ (Θ)  
immobilized in rotation ~~by adequate means~~.

8. (Currently amended) Linear actuator according to ~~claim 6 or 7,~~ characterized in that Claim  
6, wherein the screw and nut system (14) is of the ball screw type with low friction coefficient.

9. (Currently amended) Linear actuator according to ~~any of claims 1 to 5,~~ characterized in  
~~that the~~ Claim 1, wherein said driving means (5) ~~designed capable of~~ for converting the rotational

motion of the rotor (4) into a linear displacement ~~adopt the form~~ is comprised of a system (14A) of the type roller (40) and cam (41), the roller (40) associated with the control organ (O) evolving along a circular cam (41) put into rotation, directly or indirectly, by the rotor (4).

10. (Currently amended) Linear actuator according to ~~any of claims 1 to 5, characterized in that the~~ Claim 1, wherein said driving means (5) ~~designed capable of for~~ converting the rotational motion of the rotor (4) into a linear displacement ~~include~~ comprises a first cam (41) and a second cam (41A) with crossed profiles ~~designed capable of being rotated~~ rotatable with a differential speed, in order to impart to a roller (40A), in the form of a pin, an axial sliding ~~capable of~~ causing the translation of the control organ (O).

11. (Currently amended) Linear actuator according to ~~any of the preceding claims, characterized in that the~~ Claim 1, wherein said detection device (25) ~~consists of~~ comprises magneto-sensitive elements, such as Hall sensors (26), integrated into the stator (3) of the motor (3) ~~so as to be capable of detecting the magnetic poles (7) of the rotor (4) being detectable to the~~ elements.

12. (Currently amended) Linear actuator according to claim 11, ~~characterized in that the~~ wherein said detection device (25A) ~~consists of~~ comprises a linear position sensor (27) associated with the control organ (O).

13. (Currently amended) Linear actuator according to ~~any of the preceding claims,~~  
~~characterized in that the~~ Claim 1, wherein said motor (2) comprises a rotor (4) including N pairs of  
rotor poles (7) radially magnetized in an alternate direction, N being greater or equal to four, while  
being different from a multiple of three, the stator (3) ~~including~~ comprising  $P \times 9$  identical poles (8)  
spaced apart by  $40^\circ/P$ , said stator poles (8) being grouped consecutively three by three, so as to  
define a W-shaped circuit, grouping three consecutive stator poles (8) the central stator pole of which  
carries the coil (9) of the corresponding phase (10), said central stator poles (8) of two W-shaped  
circuits, each corresponding to a phase, being angularly spaced apart by  $120^\circ$ .